REACTIVE-CHEMICAL-TRANSPORT SIMULATON TO STUDY GEOTHERMAL PRODUCTION WITH MINERAL RECOVERY

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RESEARCH OBJECTIVES

Vast reserves of dissolved minerals exist in the hypersaline brines of geothermal fields at Imperial Valley, California. Recovery of zinc from geothermal brines is taking place in this area, and recovery of silica, manganese, silver, lead, and lithium has been or is being considered. Consequently, the ability to model mineral recovery is very important in terms of economic development and resource utilization.

APPROACH

The reactive-geochemical-transport simulator TOUGHREACT (Xu and Pruess, 1998) has been used to model rock-fluid interactions during production from and injection into the hypersaline-brine geothermal system. The modeling uses published water-chemistry data from Imperial Valley and a simplified flow system intended to capture realistic features of the hydrothermal system. Simulations were performed using different production and injection rates, pH values, and silica concentrations of the injection water.

ACCOMPLISHMENTS

Results indicate that the evolution of temperature and zinc concentration depends on production and injection rate. A lower rate results in a lower temperature drop and higher zinc concentration. A low injection pH significantly enhances the dissolution of sphalerite (ZnS) in the reservoir rock, increasing aqueous zinc concentration. A higher injection silica concentration leads to silica precipitation, but decreases the reservoir porosity only slightly (even after 20 years). Simulated evolution of the aqueous zinc concentration at observation and production wells is shown in Figure 1. (The observation well is located between the injection and production wells.)

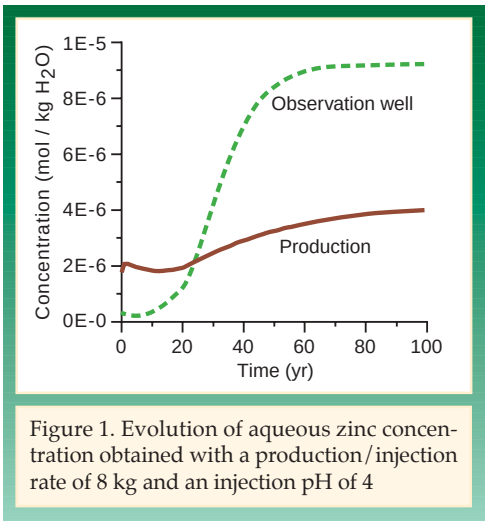

Figure 1. Evolution of aqueous zinc concentration obtained with a production/injection rate of 8 kg and an injection pH of 4

SIGNIFICANCE OF FINDINGS

This "numerical experiment" provides useful insight into the process mechanisms, conditions, and parameters controlling zinc recovery in the reservoir. This project also demonstrates that TOUGHREACT can be a useful tool for simulating these kinds of problems.

RELATED PUBLICATIONS

Pham, M., C. Klein, S. Sanyal, T. Xu, and K. Pruess, Reducing cost and environmental impact of geothermal power through modeling of chemical processes in the reservoir, in Proceedings of Twenty-Sixth Workshop on Geothermal Reservoir Engineering, Stanford University, California, January 29–31, 2001.

Xu, T., K. Pruess, M. Pham, C. Klein, and S. Sanyal, Reactive chemical transport simulation to study geothermal production with mineral recovery and silica scaling, Geothermal Resources Council Annual Meeting, San Diego, California, August 26–29, 2001.

ACKNOWLEDGMENTS

The present work was funded by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Power Technologies, Office of Wind and Geothermal Technologies, of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098. This work is a continuation of Pham et al. (2001), which is funded by California Energy Commission's Energy Innovations Small Grant Program to GeothermEx, Inc. (Grant Number 51391A/99-25).